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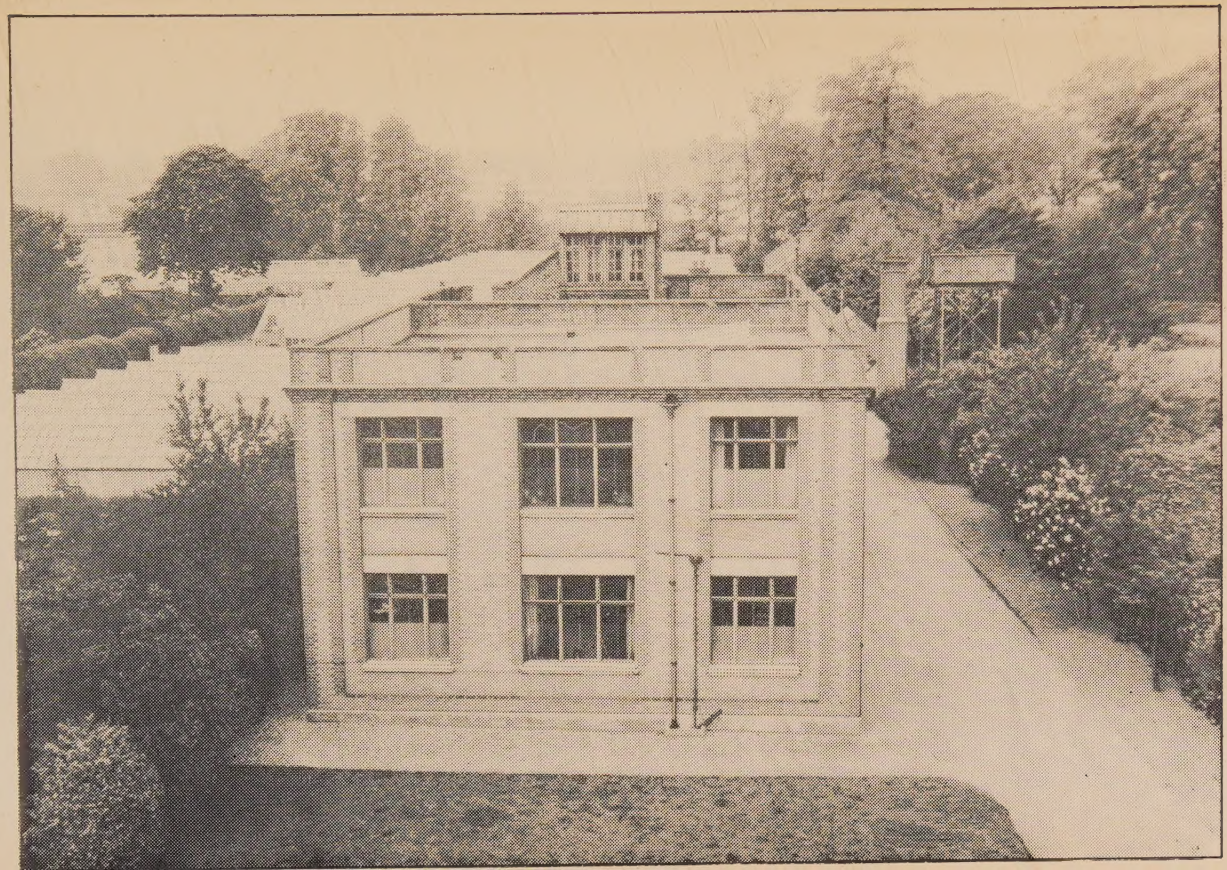

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Introduction.

THE year 1939 will long be remembered as a year of doubts and fears arising from the International Situation, which culminated in the outbreak of war with Germany on 3rd September.

The last four months of the year saw the change over from peace to wartime conditions with all their readjustments, unusual regulations and difficulties, but the British grower, strong in his resolve to increase food production and assist the country to the utmost of his powers, bore it all with good grace and settled down quietly to the job in hand.

The National policy of increased food production means that growers of crops under glass must increase their acreage of tomatoes during the summer and fresh vegetables and salads during the winter. To provide more room in the glasshouses for food crops, growers have been asked to reduce the area devoted to flowers by 25%. These changes from flowers to food crops, and the cultivation of vegetables not usually grown on a large scale, increased the need for technical assistance from Research Stations, and therefore arrangements had to be made for extending the advisory service available at Cheshunt. As light is the most important factor in glasshouse work, it seemed likely that most of the autumn and winter cultivation of vegetables and salads would take place in the more favoured parts of the country, especially in the South of England, and therefore the offices and a small advisory team were transferred to 129, Brighton Road, Worthing.

The team consists of the Director, Messrs. P. H. Williams, A. A. Richards and J. E. Morton. Members of the Staff of the Station whose work depends upon

laboratory accommodation remain at Cheshunt under Mr. E. R. Speyer, while the Extension Officer also remains behind to attend to the needs of the Lea Valley and surrounding districts. The Director is in constant touch with and makes frequent visits to the Research Station.

In this way it is hoped to maintain the research work and also give more practical assistance to growers in other parts of the country. Incidentally the scheme has an additional advantage, for it is providing the Staff with an excellent opportunity of making a close study of an important part of the country where soils and conditions differ considerably from those at Cheshunt.

The clean seed scheme which has been under consideration for some years, is now in full swing. A separate company has been formed to take over the work and has been registered under the Companies Act, 1929, as the "Market Growers' Seed Association, Limited."

The nursery has been built on a site of 7½ acres at Hammond's Mill Farm, Hassocks, Sussex. It consists of eight houses each 100 feet long and 15 feet wide, built in pairs. Last year the varieties grown were Potentate (four houses), Ailsa Craig (two houses), and E.S.1 (two houses). Some 35 lbs. of seeds have been sold to shareholders in the company and the results obtained from the 1940 crops are awaited with interest.

Members' Day was held on 25th May, when after a morning session of lectures some 120 visitors attended lunch in the Halsey Masonic Hall. During the afternoon 200 members and friends inspected the laboratories and experimental houses. Tea was very kindly provided by the President, Mr. C. H. Shoults, to whom we are very grateful. Thanks must also be recorded to Mr. E. Stevens and Mr. A. A. Pollard, J.P., for gifts of roses to decorate the tables.

Membership.

Membership of the Society, under whose auspices the experiments are conducted, is open to all growers Subscriptions are payable at the rate of two guineas for each acre of glass cultivated by the subscriber ; in return members receive all publications and any advice which is available. Members continue to be enrolled, but many more are needed, both to provide additional funds for research and to obtain co-operation in controlling the various pests and diseases common to glasshouse plants. Serious outbreaks over a wide area must be fought by all the growers ; isolated attempts to control disease are almost bound to fail.

Endowment Fund.

An endowment fund has been opened to receive contributions from those who desire to further the work of the Station. The capital is invested in Trustees and the interest only will be used for (*a*) future development, and (*b*) repayment of debt.

It is hoped that those who can possibly contribute to this fund will do so, and so help to secure the Station's future prosperity.

Current Investigations.

Owing to the incidence of the tomato root eelworm, *Heterodera marioni*, in the soils of the glasshouses, the whole nursery was steam sterilized during the autumn of 1938.

The current investigations were designed to determine the effect of certain treatments on freshly steamed soil.

In house 2 plants were grown in cardboard containers 7 in. × 7 in. × 7 in., in 10 in. clay pots and in the ground. The earliest pickings occurred from the plants in pots and boxes, but the crop was heaviest when the plants were planted directly in the ground. Similar trials were arranged in houses 7 to 10. Plants were planted in the ground, in 10 in. clay pots and in 7 in. × 7 in. × 7 in. cardboard

containers, under half of which slates were placed to restrict root action until it became necessary to remove them to allow the roots to penetrate the soil beneath. The plants in the ground gave a slightly heavier yield than the boxes, with the pots giving the lowest yield. Fruit was picked first from the pots, however, and the quality was superior.

In houses 4 to 5 plants were grown in the ground and different fertilisers added to different plots, namely, potash only ; bonemeal and potash ; hoof and horn, bonemeal and potash ; stable manure, hoof and horn, bonemeal and potash. The lowest yield was obtained where the three fertilisers and horse manure were applied. Bonemeal and sulphate of potash gave a higher yield than potash only, but the addition of hoof and horn to these two reduced the yield. The crop was earliest where no nitrogen was applied.

The variety trials were continued in house 1. The highest yield was given by two crosses, one between E.S.1 and Potentate, and another between E.S.1 and Ideal. Unfortunately, the fruit was a poor shape and the strains require a good deal of further selection before they can be of any value in commercial work. The latest strain of the leaf mould resister, E.S.1 × Up-to-date × Radio, grown in part of house 4, gave a yield of 51·51 tons per acre.

The cucumber experiments were concerned with the physical nature of the beds. Three different mixtures were used, namely, soil and horse manure ; soil and straw ; soil, horse manure and straw. Half the beds were made up as ridges and half as mounds.

In ridge beds the soil and straw gave the lowest yield ; soil and horse manure followed but the highest yield came from beds composed of soil, horse manure and straw. In mounds the same mixture gave the highest yield, but the yield from the soil and straw was slightly higher than from the soil and horse manure. Where soil and straw only were used extra nitrogen was given to compensate for the deficiency.

The tests shewed clearly the value of maintaining an open compost by the incorporation of straw in the beds.

Cheshunt Early Giant lettuce was grown on the steam sterilized soil before the tomato crop. The quality of the lettuce was not up to standard owing to the richness of the soil, and cutting was delayed longer than usual. Steamed soil is not really satisfactory for lettuce.

Cheshunt Early Ball again proved an excellent variety for cold frames.

Emulsions of carbon di-sulphide gave good results in small-scale trials in the control of wire worm, but no safe method of destroying the insect on land bearing a crop has yet been devised.

Investigation of control measures for destroying the larvæ of Sciarid flies attacking cucumber roots are proceeding.

Applications of Pyrethrum powder to mushroom beds have given results as good as those obtained by atomisation of Pyrethrum and Derris extracts with apparatus employed in the treatment of warehouses.

It has been established that applications of Pyrethrum powder can be relied upon to exterminate Rose Thrips in a short time, provided they are begun in early spring and in absence of bright daylight.

Carnation Tortrix was recorded as attacking tomato plants in Guernsey in January: the injury caused was apparently not serious.

All available information concerning pests of vegetables grown under glass has been collected, and problems concerning fumigation with hydrocyanic acid gas during the winter months are under investigation. Sprays containing Derris or Lonchocarpus powders have been found of great value in preventing autumn and winter feeding caterpillars from causing injury to glasshouse vegetable crops.

The Cucumber root-rot investigations have been continued. Certain bacteria isolated from diseased cucumber roots have been tested for pathogenicity, but none have proved capable of causing rot under the experimental conditions.

Tomato wilt caused by *Fusarium bulbigenum* var. *lycopersici* is of considerable importance in Guernsey. Numerous specimens of diseased plants have been received and it is hoped to map the distribution of the disease in the Island, especially in relation to that of *Verticillium* wilt which also appears to be widespread. Experiments on *Fusarium* wilt have also been started.

The effect of temperature on chrysanthemums infected with *Verticillium* was investigated. Results shew that although complete control of the wilt organism was not effected, fewer plants were attacked at the higher temperatures used.

A hitherto unrecorded bulb rot of narcissus was found to be caused by *Phytophthora megasperma*.

The study of mosaic diseases of certain members of the Leguminosæ has been continued. The virus of common bean mosaic proved to be the same as the American bean virus 1, and is transmitted in the seed.

Several viruses of pea and sweet pea have been identified.

Work is being carried out with strains of tomato mosaic and single virus streak diseases, in an attempt to co-ordinate the diverse symptom-pictures of these widespread diseases under various soil and environmental conditions.

Protective inoculations of young crop plants with mild strains of these viruses is also being investigated.

Serious attacks by *Rhizoctonia* sp. on mature cauliflower plants in frames, and upon seedlings in boxes have been recorded. Formalin sterilization of the soil gave effective control of *Fusarium* root-rot upon a nursery.

Tomato plants grown in a solution of nutrient salts by the soil-less culture method gave average yields of 3·01 to 4·7 lbs. per plant according to variety : these were much lower than those obtained by ordinary growth in soil. In a small scale trial, cucumber plants gave a yield of 160 lbs. per plant which was considerably higher than the average yield of 48·3 lbs. per plant from plants grown normally in the same glasshouse. Plants grown in mounds of peat watered with the nutrient solution gave a much lower yield.

Experiments have been carried out to test American claims that the bean crop is favoured by a day period as short as seven hours. In the case of dwarf "Canadian Wonder" the crop was increased by 70% while vegetative growth was reduced. The glasshouse runner bean, "Tender and True," gave no crop increase, but assumed a dwarf habit.

Further determinations have confirmed that the amount of nitrogen lost through liberation of ammonia at the surface of tomato soil has practically no commercial significance.

As the result of the examination of nursery soils, it is suggested that magnesium deficiency may be an important cause of crop injury.

Among the increased number of fertilisers submitted for examination, fish and whale guanos have been included.

In view of a possible shortage of nitrogenous fertilisers attempts are being made to devise a quick method for measuring the rate at which the nitrogen may become available in promising substitutes.

DIRECTOR'S REPORT.

1. Experimental Results of 1939.

1. Tomatoes.

The practice of grading the tomato fruits from the experimental plots, adopted in 1921, was continued.

A.—"Pinks" number 5 to 7 and "Pink and White" 8 to 10 to the lb. These are the best quality of fruit in size, shape, and colour; "Pinks" being slightly larger than "Pink and Whites."

B.—"Whites." These fruits are of good colour but smaller than "Pink and White."

C.—"Blues." This grade consists of fruits of good colour but larger and more irregular in shape than Grade A.

D.—"Roughs." Small mis-shapen fruits about the size of cherries.

E.—Blotchy fruits which ripen irregularly.

F.—Fruits shewing Blossom End Rot.

G.—Fruits shewing the lesions of Stripe Disease.

H.—Fruits shewing "Green Back."

(a) Houses 2 and 7 to 10. Root restriction experiment with steam sterilized soil.

The experiments on the effect of root restriction on the fruiting of tomato plants has been in progress since 1936, using normal unsterilized soil in which the numbers of the eelworm, *Heterdera marioni*, were gradually increasing. The attack became so severe in 1938 that the soil was steamed by the Hoddesdon pipe system during the autumn. This year, therefore, all the experiments have been conducted with freshly steamed soil, on which a crop of Cheshunt Early Giant lettuce was grown before the tomato crop.

In house 2 there were eight plots. In two the plants were planted directly in the ground, in two they were planted in 10 inch pots stood on the ground so that the roots could grow through into the soil below, and in four others they were planted in cardboard containers measuring 7 inches each way.

The results are given in Table 1. The yield was highest where the plants were planted in the ground, and that from boxes was higher than from the pots. The crop was earliest from the pots and the quality of the fruit was better in both boxes and pots than it was from plants grown directly in the ground.

Table 1.

House	Plot	Treatment	Crop weight in lbs. per plant						Total tons per acre	Average tons per acre	Average lbs. per plant in June
			May	June	July	Aug.	Sept.	Total			
2	3	Planted in the ground	—	0·69	2·81	0·86	0·33	4·67	35·64	35·45	1·01
	8	,, ,, ,, ...	0·01	1·32	2·42	0·51	0·38	4·64	35·26		
	2	Planted in 10 in. pots	—	0·96	2·09	0·72	0·45	4·22	32·07	32·04	1·02
	6	,, ,, ,, ...	—	1·08	2·12	0·73	0·28	4·21	32·00		
	1	Planted in cardboard containers, 7 in. × 7 in. × 7 in.	0·18	1·02	2·08	0·78	0·44	4·50	34·20	34·29	0·92
	4	,, ,, ,, ,, ,,	—	0·94	2·27	1·04	0·31	4·56	34·66		
	5	,, ,, ,, ,, ,,	—	0·54	2·53	0·96	0·48	4·51	34·28		
	7	,, ,, ,, ,, ,,	—	0·97	2·21	0·93	0·37	4·48	34·02		

Table 2.

House	Plot	Treatment	Crop weight in lbs. per plant						Total tons per acre	Average tons per acre	Average lbs. per plant in June
			May	June	July	Aug.	Sept.	Total			
7	2	Planted in the ground	—	1.38	3.48	2.00	0.94	7.80	59.29		
	6	,, ,, ,, ...	—	1.00	2.41	1.67	0.82	5.90	44.84		0.80
8	2	,, ,, ,, ...	—	0.68	2.67	1.71	1.05	6.11	46.44		
	5	,, ,, ,, ...	—	0.14	2.32	2.19	1.46	6.11	46.44	48.00	
9	2	,, ,, ,, ...	—	0 08	3.03	2.34	0.78	6.23	47.35		
	4	,, ,, ,, ...	—	0.03	2.94	2.77	0.79	6.53	49.62		0 08
10	6	,, ,, ,, ...	—	0.10	2.61	2.34	0.80	5.85	44.46		
	8	,, ,, ,, ...	—	0.12	2.64	2.07	1.17	6.00	45.60		
7	3	Planted in 7 in. x 7 in. x 7 in. cardboard	—	1.13	1.98	1.63	1.15	5.89	44.76		
	7	containers	—	1.03	2.21	1.73	0.80	5.77	43.86		0.80
8	4	,, ,, ,, ,,	—	0.73	2.31	1.91	1.39	6 34	48.18		
	8	,, ,, ,, ,,	—	0.20	3.25	2.05	1.32	6.82	51.84	45.82	
9	6	,, ,, ,, ,,	—	0.16	1.79	2.72	0.69	5.36	40.74		
	8	,, ,, ,, ,,	—	0.32	2.47	2.22	0.74	5.75	43.70		0.17
10	4	,, ,, ,, ,,	—	0.05	1.99	2.67	1.00	5.71	43.40		
	7	,, ,, ,, ,,	—	0.15	2.19	2.03	0.63	5.00	38 00		

Table 2 *(continued).*

House	Plot	Treatment	Crop weight in lbs. per plant						Total tons per acre	Average tons per acre	Average lbs. per plant in June
			May	June	July	Aug.	Sept.	Total			
7	1	Planted in 7 in. x 7 in. x 7 in. cardboard	—	1.49	2.17	1.98	1.33	6.97	52.98		
	4	containers with a slate beneath	—	1 56	2.10	2.01	1.24	6.91	52.51		0.90
8	6	which was pulled out when the	—	0.31	2.72	1.98	1.21	6.22	47.28		
	7	3rd truss had set	—	0.26	3.24	1.63	1.15	6.28	47.72	45.33	
9	1	,, ,, ,, ,,	—	0.20	3.25	2.05	1.32	6.82	51.84		
	5	,, ,, ,, ,,	—	0.13	1.67	2.58	0.78	5.16	39.22		0.09
10	2	,, ,, ,, ,,	—	0.17	2.19	2.44	0.81	5.61	42.65		
	5	,, ,, ,, ,,	—	0.04	1.94	2.36	0.73	5.07	38.53		
7	5	Planted in 10 in. pots	—	1.37	2.26	1.83	1.05	6.51	49.48		
	8	,, ,, ,, ...	—	1.34	2.43	1.74	0.82	6.33	48.11		1.22
8	1	,, ,, ,, ...	—	1.13	2.17	1.76	1.27	6.33	48.11		
	3	,, ,, ,, ...	—	1.06	2.07	1.78	1.32	6.23	47.36	43.95	
9	3	,, ,, ,, ...	—	0.07	2.93	1.93	0.70	5.63	42.79		
	7	,, ,, ,, ...	—	0.46	2.19	1.78	0.68	5.11	38.85		0.37
10	1	,, ,, ,, ...	—	0.55	2.50	1.41	0.67	5.13	39.00		
	3	,, ,, ,, ...	—	0.40	2.27	1.56	0.76	4.99	37.93		

In houses 7 to 10, there were eight plots in each house. In two the plants were set out in the ground, two in 10 in. pots and four in cardboard containers 7 in. × 7 in. × 7 in. In two of these last four plots, however, a slate was inserted underneath the box to prevent the roots from entering the soil below too soon. In this way the roots were kept in the boxes so that vegetative growth was prevented from being too luxuriant in the steamed soil. Three trusses of fruit were set on these beautifully balanced plants and then the slates were pulled out and the roots allowed to grow into the soil below.

This method can be recommended to all who have difficulty with soft luxuriant plants, for by it the type of growth can be controlled to a nicety.

Houses 7 and 8 were planted with the variety E.S.1 and Nos. 9 and 10 with Ailsa Craig.

The results are given in Table 2, and it will be seen that they confirm those obtained in house 2.

In summing up the results of four years' experiments it will be seen that the value of containers is greatest in old soils, which have not been steam sterilized, except where growth in sterilized soil is too strong, when they are useful in helping to control it. On unsterilized soil the use of boxes especially can be recommended. They enable the plants to be supplied with a suitable soil mixture during the early part of their life and lift them above a contaminated subsoil. They are warmer than the ground below and the water content can be more easily controlled. They restrict root action at the beginning of the crop, improve quality and give earlier crops.

(b) Manurial treatment after steaming

House 5 and part of house 4 was devoted to this experiment. There were four different treatments as follows, in which fertilisers were forked into the top 8 in. of soil before planting; the horse manure being buried at the usual depth:—

1. Sulphate of potash only.
2. Bone meal and sulphate of potash.
3. Hoof and horn, bone meal, and sulphate of potash.
4. Hoof and horn, bone meal, and sulphate of potash with horse manure.

The rate of application was 10 cwt. per acre in the case of each fertiliser and 15 tons per acre of horse manure.

The results are given in Table 3.

Table 3

House	Plot	Treatment	Crop weight in lbs. per plant						Total tons per acre	Average tons per acre	Average % blotchy fruit	Average lbs. per plant in May
			May	June	July	Aug.	Sept.	Total				
4	5	Sulphate of potash only ...	0.03	1.69	1.88	0.75	0.56	4.91	37.30	39.92	2.68	0.04
5	2	,, ,, ,, ...	0.08	1.74	1.99	0.87	0.22	4 90	37.23			
	4	,, ,, ,, ...	—	1.07	3.12	1.12	0.94	5.95	45.23			
4	6	Bone meal and sulphate of potash	0.03	2.43	2.44	1.18	0.70	6.78	51.51	45.62	3.59	0.04
5	5	,, ,, ,, ,,	—	1.13	3.49	1.22	0.38	6.22	47.27			
	8	,, ,, ,, ,,	0.08	2.03	1.95	0.70	0.25	5.01	38.07			
4	8	Hoof and horn, bone meal and sulphate of potash ...	—	0.82	1.60	1.74	0.71	4.87	37.15	40.22	3.59	0.02
5	1	,, ,, ,, ,,	0.04	2.09	1.79	0.91	0.21	5.04	39.06			
	6	,, ,, ,, ,,	0.02	1.22	2.91	1.32	0.38	5.85	44.46			
4	7	Stable manure, hoof and horn, bone meal and sulphate	—	1.51	2.24	1.00	0.65	5.40	41.03	35.87	4.26	0.02
5	3	of potash	—	1.21	2.58	0.82	0.53	5.14	39.06			
	7	,, ,, ,, ,,	0.07	0.23	2.37	0.81	0.14	3.62	27.51			

Table 4

House	Plot	Treatment	Crop weight in lbs. per plant						Total tons per acre	Percentage blotchy ripening
			May	June	July	Aug.	Sept.	Total		
4	1	No nitrogen...	0.18	2.16	0.40	0.22	0.18	3.14	23.85	16.27
	2	Untreated	1.63	0.50	0.20	—	0.20	2.53	19.23	71.24
	3	Complete artificials	0.04	2.46	0.34	0.41	0.50	3 75	28.49	6.96
	13	Complete artificials + stable manure... ...	0.05	2.08	2.02	0.67	0 33	5.15	39.15	3.11
	14	No phosphates	—	2.12	1.08	0.76	0.32	4 28	32.54	5.60
	15	No potash	—	1.72	0.55	0.34	0.28	2.89	21.97	62.28

It will be seen that whereas the crop yield was increased by applying both bone meal and sulphate of potash, the addition of hoof and horn and stable manure both had a depressing effect.

The percentage of blotchy ripening increased as the soil became unbalanced through excess of nitrogen, and the crop became later.

This is in keeping with experience on commercial nurseries.

(c) Fertiliser deficiency.

Plots 1, 2, 3, and 13, 14, 15, in house 4, have received the same treatment during the past twenty-four years.

Results have been given from time to time and are included again this year in Table 4.

They confirm once again the relation between potash supply and the incidence of blotchy ripening. In the control plot 3% of the total fruit suffered from blotchy ripening. Where potash had been omitted the amount was 62%, and where no fertilisers at all had been applied it was 71%.

(d) Variety trials.

Variety trials were continued in house 1. The results were mediocre, but the highest yields were given by two crosses, namely, E.S.1 × Potentate and E.S.1 × Ideal. Unfortunately, the quality and shape of these strains were not up to commercial standard. The results are given in Table 5.

The leaf mould resister, E.S.1 × Up-to-date × Radio, gave an excellent crop of 51 tons per acre in part of house 4.

Potentate has been very carefully selected to reduce the percentage of bad shaped fruit (blues), and virus free seed was used for the plants in house 11.

The results are given in Table 6.

The plants being free from virus diseases remained strong and healthy to the end of the season and were still in excellent condition when the time came to remove them. The average crop weight was 70 tons per acre. They gained the admiration of all who saw them, and constituted an excellent advertisement for virus free seed. The control crop from ordinary seed yielded 52·7 tons per acre.

Table 5.

Variety	Crop weight in lbs. per acre					Total tons per acre	Quality of fruit: Percentage in each grade				
	June	July	Aug.	Sept.	Total		A	B	C	D	E
E.S.1 x Potentate	0.78	3.47	1.20	0.59	6.04	45 90	61	12	14	3	10
E.S.1 x Ideal	0.17	3.02	1.47	0.95	5.61	42.64	66	10	14	4	5
Potentate	0.65	3.59	0.87	0.41	5.52	41.95	43	7	31	7	12
Potentate x Kondine Red	0.05	1.63	2.13	1.58	5.39	40.96	75	12	5	3	5
Ideal x (E.S.1 x Up-to-date) x Potentate	0.55	3.41	0.88	0.44	5.28	40.13	57	10	21	3	8
Bides Recruit x Potentate x Ideal	0.33	3.54	0.91	0.47	5.25	39.90	36	9	41	3	11
E.S.1 x Master Marglobe	0.56	3.33	0.95	0.34	5.18	39.37	64	16	7	4	6
Ideal	0.32	3.63	0.72	0.17	4.84	36.78	41	7	37	4	11
Best of All (T)	0.41	2.84	1.05	0.44	4.74	36.02	51	12	26	5	6
Ideal x E.S.1	0.30	3.41	0.70	0.26	4.67	35.49	58	16	15	5	5
E.S.1	1.16	2.24	0.72	0.40	4.52	34.35	73	19	1	4	3
Solidarity	0.37	2.70	0.98	0.41	4.46	33.90	46	12	31	5	5
Kondine Red	0.63	2.82	0.74	0.25	4.44	33.74	52	9	32	2	5
Jubilee x Ideal	0.74	2.76	0.59	0.32	4.41	33.51	71	13	10	2	3
Blaby x Potentate	0.41	2.96	0.86	0.44	4.40	33.44	40	9	20	11	16
Nicholson's variety	0.68	2.94	0.64	0.12	4.38	33.28	62	23	3	9	3

Variety:—Potentate—Virus free seeds.

Table 6

House	Plot	Treatment	Crop yield in lbs. per plant					Total tons per acre
			June	July	Aug.	Sept.	Total	
11	1	Standard	1.27	3.73	2.82	2.31	10.14	77.06
	2	Standard	0.41	3.46	2.70	2.19	8.76	66.58
	3	Standard	0.86	3.41	2.54	1.90	8.71	66.20
	4	Standard	1.13	3.95	2.33	1.86	9.27	70.45

2. Cucumbers.

The cucumber experiments were designed to ascertain the effect of mixing plain wheat straw in cucumber beds. The composts used were as follows :—

(*a*) Two parts turfy soil; one part long horse manure.

(*b*) Two parts soil; one part straw.

(*c*) Two parts soil; one part horse manure; one part straw.

Where straw was used in the absence of horse manure the nitrogen deficiency was made up by top-dressing with dried blood one month after planting.

Half the beds were formed in ridges, while in the remainder the plants were set out singly in mounds of compost.

The results are given in Table 7, from which it will be seen that the crop weight from ridges is invariably greater than from the mounds. Further, while the addition of straw to a mixture of soil and horse manure increases the yield, the use of straw instead of stable manure depresses it.

The practice of mixing straw in cucumber beds of normal composition is becoming increasingly popular in commercial work, for it assists in maintaining a healthy root action because it keeps the bed open. It is best to keep the straw in almost vertical walls across the beds with the haulms vertical. These walls can be introduced easily when making up the beds.

3. Lettuce.

Successful crops of Cheshunt Early Giant lettuce were grown before the tomato crop, but the quality of the heads was not up to standard, owing to the richness of the steamed soil. The heads were looser than usual and the period of growth was longer.

After the cucumber crop was finished the beds in one house were skimmed to remove the loose material and then the remainder of the compost was turned over and dug into the soil beneath.

Cheshunt Early Giant was planted on 12th September in one bed and a new hybrid (Cheshunt Early Giant × Green Frame) was planted in the other. The new hybrid proved more suitable for this type of rich soil than Cheshunt Early Giant and an attempt is being made to obtain sufficient seed for trial next year. Good lettuce with tight hearts were cut seven weeks after planting, whereas Cheshunt Early Giant gave looser hearted heads and took a fortnight longer to mature.

Table 7

House	Plot	Composition of beds	Crop yield in lbs. per plant								Total tons per acre	Total flats per foot
			Mar.	April	May	June	July	Aug.	Sept.	Total		
		Beds: 2 parts soil and 1 part										
C	2	manure	1.36	7 58	11.33	10.65	8.59	6 85	0.40	46.76	70.14	1.42
D	1	,, ,, ,,	0 88	7.10	7.49	7.24	6.33	6.39	0.92	36.35	54 53	1.10
	6	,, ,, ,,	1.92	7.69	8.70	9.28	9.36	5.42	0.49	42.86	64 29	1.30
F	6	,, ,, ,,	2.32	7.54	9.19	10.57	10.74	6 97	0.98	48.31	72.47	1.47
G	1	,, ,, ,,	2.16	12.23	9.22	14.86	4.41	12.90	3.65	59.43	89.15	1 80
	4	,, ,, ,,	2.31	10.04	12 54	14.86	6 66	16.41	1.76	64.58	96.87	1.96
	7	,, ,, ,,	2.26	12.38	6.71	15.84	4.62	13.06	4.09	58.96	88.44	1.79
C	4	Mounds	2.09	7.38	9.52	8.86	6.71	5.60	0.68	40.85	61.28	1.24
D	3	,, ,, ,,	1.54	9.13	10.35	8.36	10.24	5.17	0.13	44.92	67.38	1.36
	8	,, ,, ,,	1.47	8.14	8.71	8.97	8 91	7.27	0.77	44 24	66 36	1.34
B	2	,, ,, ,,	1.49	8.85	8.81	10.68	9.68	7.78	1.19	48.48	72.72	1.47
	6	,, ,, ,,	2.01	8.51	9.12	10.81	9.54	7.23	0.50	47.72	71.58	1.48
	8	,, ,, ,,	1.92	8.42	8.82	10.16	8.57	7.35	0.95	46.19	69.29	1.40
F	4	,, ,, ,,	1.97	8.06	9.91	9.06	8.88	6 39	0.69	44.96	67.44	1.36
C	1	Beds: 2 soil and 1 straw ...	1.58	8.86	10.13	9.02	7.15	6.75	0.80	44.29	66.44	1.34
D	2	,, ,, ,,	0.60	9.17	8.74	9.07	9·52	6 44	0.09	43 63	65.45	1.33
	5	,, ,, ,,	1.18	9.86	9.81	9 56	9.24	6.22	0.76	46.63	69.95	1.41
F	2	,, ,, ,,	1.25	9.24	8.90	9.20	9.72	7.18	0.84	46.33	69.50	1.40
G	2	,, ,, ,,	2.39	10 52	9.86	13.97	6.10	11.45	1.83	56.12	84.18	1.70
	3	,, ,, ,,	2.83	9 98	13.61	12.88	6.72	10.98	1.03	58.03	87.05	1.76

49.17

(Continued on page 26.)

Table 7 *(continued).*

House	Plot	Composition of beds	Crop yield in lbs. per plant									Total tons per acre	Total flats per foot
			Mar.	April	May	June	July	Aug	Sept.	Total			
E	4	Mounds	0.88	8.78	10.39	9.99	8.29	8.36	0 84	47.53	46.21	71.30	1.44
	7	,, ,, ,,	1.24	8.73	9.37	10.71	8.13	7.85	1.04	47 07		70.61	1.43
F	8	,, ,, ,,	2 36	8.78	7.57	9.00	8.77	6.56	0.98	44.02		66.03	1.33
		Beds: 2 soil, 1 manure and											
C	3	1 straw	2.09	7.17	10.21	10.35	9.59	6.83	0.22	46 46	53.95	69.69	1.41
F	1	,, ,, ,,	2.04	7.92	9.20	9.93	9.18	8.73	0.98	47.98		71.97	1.45
	5	,, ,, ,,	2.41	8.31	10.82	12 27	11.09	8.80	0.65	54.35		81.53	1.65
G	5	,, ,, ,,	2.10	10.97	9.45	12.13	7 57	12.80	2.40	57.42		86.13	1 74
	6	,, ,, ,,	1.91	12.32	8.24	11.38	7.04	12 34	2.13	55 36		83.04	1.68
	8	,, ,, ,,	2.45	12.68	8.37	16.83	5.12	12.47	4.19	62.11		93.17	1.89
D	4	Mounds	1.43	8.05	11.06	10 32	11.17	6.06	0.41	48.50	48.54	72.75	1.47
	7	,, ,, ,,	1.87	8.83	9.78	9.05	7.43	6.55	0.89	44.40		66.60	1.38
E	3	,, ,, ,,	1.34	8.10	9 25	10 62	9.34	10.08	1.46	50.19		75.29	1.52
	5	,, ,, ,,	2.03	9.56	10.64	10 71	9.40	7.65	0.96	50.95		76.43	1.53
F	3	,, ,, ,,	1.67	9 40	10.88	9.97	9.43	7.85	1.18	50.38		75.57	1.53
	7	,, ,, ,,	2.20	10.44	8.53	9.10	8.90	6.67	0.96	46.80		70.20	1.42

4. Other Vegetables.

In view of the International situation it was decided to experiment with other vegetables to obtain information for future work.

In the cucumber houses the beds were treated as for the lettuce, and then sown or planted as follows:—

House D. ... East Side ... Carrots (Harrison's Broadcast).
House D. ... West Side ... Turnips, Early Milan.
House E. ... East Side ... Longpod Broad Bean.
House E. ... West Side ... Cauliflower, White King.
House F. ... ... Lettuce.
House G. ... East Side ... Dwarf Bean, Canadian Wonder and Lightning.
House G. . . West Side ... Dwarf Bean, Canadian Wonder.

The cultivation details are given below.

Crop	Sown		Date of Planting	Date of Marketing	Temperature of house
	Date	Manner			
Carrots ...	25/9/39	Broadcast ...	—	—	50° F.
Turnips ...	25/9/39	Broadcast ...	—	1/3/40	50° F.
Broad bean...	4/8/39	In 60's in cold frame ...	25/9/39	—	50° F.
Cauliflower...	4/8/39	In boxes in cold frame	25/9/39	—	50° F.
Dwarf bean ..	4/8/39	In 60's in cold frame ...	8/9/39	12/11/39	60° F. to 65° F.

The houses were kept heated until the beginning of January, when unfortunately the hot water boiler broke down during a long spell of unusually cold weather. This destroyed the cauliflowers and seriously retarded the carrots and turnips. A few turnips were marketed at the beginning of March.

The broad beans were a failure: the flowers dropped off without any signs of "setting."

The dwarf beans were highly successful and were sold at good prices in November and December.

The work will be repeated at the end of 1940.

2. Plant Diseases.

During 1939, 383 specimens were received and reported upon. They may be roughly classified as follows :—

General Mycology (Tomatoes, etc.)	206
Virus Diseases	76
Flower Diseases	89
Vegetable Diseases	12

1. Some Diseases not Recorded Previously.

P. H. Williams.

Two samples of mushrooms attacked by *Verticillium malthousei* have been received during the year, one from Chesham, Bucks, in January and the second (by Miss Oyler) from Farnham, Surrey, in December. Fortunately, this disease which was first described by Ware in 1933, is rather rare. The mushrooms are usually deformed, and white to greyish-white in colour. The deformity is similar to that caused by *Mycogone perniciosa* but differs from it in several respects. Mushrooms attacked by *Mycogone* usually exude drops of brown liquid. This exudation is absent from mushrooms attacked by *Verticillium malthousei*. Furthermore, the fungal growth on the outside of the fruit body is less luxuriant in the *Verticillium* disease and the mushrooms do not rot so readily. There is evidence that the spores of the fungus are spread by insects and the elimination of insects is therefore an important aspect of control. All diseased mushrooms should be removed and the beds should not be damped until after their removal, to avoid splashing the spores over healthy mushrooms. The temperature of the shed should also be kept between 50° and 55° F.

Among fungi found in samples of casing soil were species of *Corethropsis*, *Geotrichum* and *Haplotrichum*. The *Haplotrichum* mycelium grew densely in the soil, binding it together. The growth of the other two fungi was sufficiently luxuriant to be plainly visible but the soil was not definitely matted together. These fungi are probably common soil inhabitants and it is not likely that they will become serious competitors with the mushroom. Where they are extremely abundant it may be advisable to scrape away a portion of the casing soil.

Young potato plants suffering from *Rhizoctonia* stem rot were brought to the Station during the summer. They were growing on land intended as a site for tomato houses in the near future. This land had been planted with potatoes for several years and the disease was reported to have gradually increased in severity. The continued cultivation of potatoes would undoubtedly have led to a thorough infestation of the soil with *Rhizoctonia solani* with consequent attacks of foot rot in tomato crops growing in houses built on this land. There is also serious risk of introducing *Verticillium* wilt from a previous infected crop of potatoes. This case emphasizes the importance of with-holding crops likely to harbour parasites of the tomato from land on which it is intended to build later. Alternatively, if such crops are grown, a proper rotation should be practised so as to prevent the accumulation of parasitic fungi in the soil.

Several cases of damage resulting from cresylic acid fumes have been recorded during the year. In one case a powder containing this substance had been dusted on the surface of the soil of pots containing young tomato plants. The plants shewed symptoms similar to those of *Phytophthora* foot rot. No fungus was found, however, and experiments proved that the damage was due to burning of the stem by the powder.

In another case, scorching of the foliage of young tomato plants in March, was traced to treatment of the staging with cresylic acid during the previous autumn. In December, several thousand newly potted tomato seedlings on a nursery in the Worthing area were killed by the fumes of this substance. The grower had washed his pots in water containing a cresylic acid compound, dried them on the pipes and used them immediately for potting up his seedlings. The result was the death of most of his plants in from twelve to twenty-four hours.

2. Fusarium Wilt of the Tomato.

P. H. Williams.

Two wilt diseases caused by *Verticillium albo atrum* and *Fusarium bulbigenum var lycopersici* respectively occur in the Island of Guernsey. These diseases are recognised as having different temperature requirements for their development as is shown by their distribution in North America where *Verticillium* wilt is found principally in Canada and the Northern States; *Fusarium* wilt predominating in the South. A survey of the distribution of these two diseases in Guernsey should, therefore, be of interest and such a survey has been started

this year. This survey should also provide important information on the effect of other factors such as soil type and drainage. Growers will assist the work considerably by sending specimens of wilted plants for examination.

At present the records are too few for any conclusions to be drawn except that the *Verticillium* disease is more common in Guernsey than was believed formerly.

No difficulty was experienced in isolating the fungus from diseased plants. Isolations were made on Hard Potato Dextrose Agar and in several cases all the tubes contained pure cultures of the fungus. It has also been isolated from the roots of diseased plants. No detailed cultural studies have been made as yet, but the fungus isolated resembles closely in growth and spore production a pure culture of *Fusarium bulbigenum var lycopersici* obtained from the Centraalbureau voor Schimmelkultures, Baarn.

Tomato plants were inoculated by pricking cultures of the fungus into the stem. No wilting was observed and the progress of the fungus as measured by the discolouration produced, was very slow. The discolouration usually involved only one or two inches of the stem and less than half the plants inoculated showed symptoms. In view of the fact that the extent of the browning in stems of naturally infected plants is usually two feet or more, the slight extent of the injury obtained in these experiments and its variation from plant to plant suggests that the method of inoculation was not ideal and that infection takes place at a comparatively early stage in the life of the plant. It is intended to continue these experiments as soon as a return to Cheshunt is possible.

3. Cucumber Root Rot.

P. H. Williams.

During previous years, attention has been directed to the effect of various cultural factors on the health of cucumber roots and to the part played by certain species of *Fusarium* in causing disease. In the past year some sixteen bacterial cultures were tested for pathogenicity. The method employed was the same as that described in previous Reports. The organisms were grown in 20 cc. Beef Extract Broth and the cultures were poured into the soil in the bottles, sufficient water being added to bring the soil to the required degree of moisture. The symptoms produced in the inoculated plants were the same as in experiments previously reported and none of the organisms tested proved to be parasitic.

It seems, therefore, from the results of the experiments described in this and previous Annual Reports that an unsuitable physical condition of the soil in pots and borders is the chief cause of cucumber root rot.

When the plants are killed or weakened by this means, they are rapidly invaded by numbers of organisms some of which, such as *Fusarium solani* and *F. orthoceras*, are weak parasites. These results are in accord with experience on commercial nurseries where tightly packed and badly drained beds are frequently associated with the death of cucumber roots.

4. Verticillium Wilt of the Chrysanthemum.

E. Oyler.

Investigation of the wilt disease of chrysanthemums described in this Report for 1937 has been continued.

Experiments were carried out to determine the effect on the fungus in the plant, of growing infected plants at different temperatures.

Stems of rooted cuttings of the varieties Cheshunt White and Favourite, both of which had been proved to be susceptible to the fungus, were inoculated above soil level with a culture of *Verticillium*. Twenty cuttings were placed in each of the following positions: outside in an unheated frame, rose house, virus house, cucumber house and melon house, the temperatures and relative humidities of which were recorded automatically.

The plants made the best growth in the open and in the rose house. The plants in the cucumber house were stunted and had very weak stems due to deficiency of light.

After thirteen weeks ten plants from each situation were examined and isolations were made from the roots and at 1 inch intervals up the stem. Six weeks later the tops of the remaining plants were cut off and rooted as cuttings and the rest of each plant was examined as before. *Verticillium* was never re-isolated from the roots and in one case only was it found below the level of the site of inoculation. *Verticillium* was re-isolated from seventeen plants, grown in the open and from seventeen plants in the rose house at distances varying from 2 to 9 inches and 2 to 10 inches above the site of inoculation respectively. In the virus and cucumber houses eleven plants were infected and the fungus was re-isolated at

distances of from 1 to 9 and 1 to 7 inches above the site of the inoculation respectively. In the melon house nine plants were infected and the fungus was re-isolated up to 6 inches above the inoculation. The results are summarised in the following Table:—

Situation	Mean Temperature °F.	Mean Relative Humidity	No. plants inoculated	No. plants infected	% age infection	*Verticillium* re-isolated: inches up stem	
						Range	Mean
Open	56	75	20	17	85	2—9	5
Rose house	61	72	20	17	85	2–10	6
Virus house	70	80	20	11	55	1—9	4
Cucumber house ...	71	86	19	11	58	1—7	3
Melon house	75	85	20	9	45	1—6	3

From the Table it is seen that at the higher temperatures fewer plants became infected, although at the end of 19 weeks the distances up the stems to which the fungus had extended did not vary greatly in any of the situations.

All the rooted cuttings were grown under the same conditions and were examined after seven weeks. Only one cutting was found to be infected, this was from one of the infected plants grown in the rose house.

The results shew that some degree of control of the fungus can be obtained by growing plants at a higher temperature than is normally used for chrysanthemums. When conditions permit it is proposed to carry out further experiments to determine the effect of growing infected plants at high temperatures for shorter periods before using the tops as cuttings.

Malachite green has been used to control various fungus diseases, notably those of turf. The effect of varying concentrations of malachite green in solid and liquid culture media on the chrysanthemum strain of *Verticillium* was examined. The results of these experiments may be summarised by stating that ninety-six hours in an aqueous solution of malachite green at a concentration of 1 : 20,000 killed cultures of *Verticillium* although cultures left in malachite green solutions for shorter periods could tolerate higher concentrations.

5. Verticillium Wilt of the Carnation.

H. L. White.

Experiments have been carried out on problems referred to in previous Reports. On the outbreak of the war these experiments were discontinued.

Transmission of the disease in the cutting.

Cuttings taken from apparently healthy plants in beds in which diseased plants occurred were struck in November and in March. Of the resulting plants 2% and 4% respectively proved to be contaminated. The contaminated plants raised from the March cuttings had all wilted by the end of July, the period of time between striking of the cutting and appearance of wilt (95 ± 10 days) not differing significantly from that found with January cuttings. It was also found that the lesions of nursery stock wilting in May, three weeks after planting, were so extensive as to indicate contamination of cuttings taken in the previous December.

These observations suggest that plants raised from contaminated winter cuttings usually shew disease symptoms in the following summer, and that a clean stock may normally be obtained from plants segregated in pots and surviving until the following August and September.

Depth of soil in relation to contamination.

Plants were potted in soil taken from positions recently occupied by wilting plants at levels varying from the surface to 18 inches depth. In five months no wilting occurred in soil extracted from a depth between 12 and 18 inches. The number of plants affected in soil from lesser depths was so small that no conclusions could be drawn.

Effects of a mercuric fungicide.

Young plants of the variety Spectrum in 12 inch pots were watered eight times at fortnightly intervals during the summer with two litres of a proprietary fungicide of comparatively low mercuric content at 0·25% dilution.

Four plants growing in soil contaminated with *Verticillium cinerescens*, and four in uncontaminated soil were treated: similar numbers of plants in clean and contaminated soil were used as controls.

Three plants of both treated and the control in contaminated soil developed the disease, and no plant in uncontaminated soil did so.

An adverse effect upon carnation plants in treated pots was evident through reduction by 44% in the growth of axillary shoots over a period of two months, and blossoming was retarded by twenty-four days.

Transmission of the disease to species of Dianthus.

Five species of Dianthus raised from seed were exposed to infection both by stem inoculation with a needle and by potting in soil containing infected carnation stems, a barrier of clean soil being interposed between the roots and the infected material. From five to ten plants of each variety were subjected to each source of infection.

A high percentage of perpetual flowering carnation plants grown in similarly contaminated soil contracted the disease. *V. cinerescens* was re-isolated from the tissues of such Dianthus plants as shewed wilting symptoms during the experiment.

Observations extended over a period of five to six months in the case of inoculation, and about nine months in that of contamination with the following results:—

D. caryophyllus (Border Carnation). Highly resistant: almost completely immune from root infection and seven out of nine inoculated plants grew away from the disease.

D. deltoides. Completely immune.

D. cæsius. Immune from root infection. Out of ten inoculated plants four wilted completely, and four shewed localised wilting.

D. chinensis. Highly susceptible to root infection: leaves became yellow and withered from base of shoots upwards, and anthocyanin pigment developed along veins. All inoculated plants wilted completely after an average period of eighty-nine days.

D. barbatus (Sweet William). Highly susceptible to root infection: out of ten plants one wilted completely and five shewed localised wilting. Out of seven inoculated plants three wilted completely.

It is notable that *D. chinensis* is reputed to be the species from which the perpetual flowering carnation has originated.

6. Virus Diseases.

(a) Virus Diseases of Leguminous Plants.

G. C. Ainsworth.

In last year's Report (p. 61) there was a note on two mosaic diseases of pea and sweet pea which had been studied in the course of a survey of the virus diseases of leguminous plants undertaken with the primary object of establishing the status of the lettuce mosaic virus. Further observations have been made on these diseases and on other viruses discovered

in the course of the survey. A more technical account of the results obtained has been prepared for publication and only the general conclusions will be summarized here.

It was not possible to relate the virus of lettuce mosaic with any other virus.

The virus of common bean mosaic (a disease not infrequently found on runner beans under glass) proved to be the same as the virus known as *Bean virus 1* in America. This virus is seed transmitted through both runner and French beans and infected seed is probably the usual source of mosaic in bean plantings. Green flies are able to transmit bean mosaic virus, which is also spread by the contact of diseased and healthy plants. No other common plants are known to be susceptible.

A number of cases of streak disease of sweet pea were examined and in every case streak symptoms were found to be associated with virus infection, and it is probable that the disease known as sweet pea streak is in reality a group of diseases, several distinct viruses being able to cause similar symptoms in sweet pea.

The characteristic streak symptoms are brown elongated lesions on the stems and leaf stalks. Lettuce mosaic virus is able to cause such symptoms in sweet pea and this type of streak may be distinguished by the normal appearance of the foliage. A second type is caused by a single virus, which besides streaking the stems mottles the leaves and breaks the flowers in a manner similar to that of the common mosaic (see last year's Report, page 61). Peas are susceptible to this virus, which also causes a streak disease in broad beans and a severe disease in French beans. A virus of the cucumber mosaic type (*Cucumber virus 1*) is implicated in a third type of streak which was found in one locality in Hertfordshire.

In the field the position is complicated because streaked plants may also be infected with one of the mosaic viruses and shew broken flowers or enations on the leaves, but these latter viruses alone appear to be incapable of causing streak.

In America tomato spotted wilt virus has been claimed as a cause of sweet pea streak, but in this country it was not until April, 1939, that spotted wilt was detected in sweet pea. The single naturally-infected plant examined, which had been grown under glass, did not shew streak symptoms but a yellow spotting and streaking of the leaves, and these were the only symptoms produced by experimental inoculation. It is, however, possible that spotted wilt virus can cause streak symptoms in outdoor grown plants.

(b) Transmission Experiment with Viruses from Monocotyledonous Plants.

G. C. Ainsworth.

During the winter of 1938-39 inoculation experiments were carried out in connection with the virus diseases of lily and other monocotyledonous plants previously noted (see last year's Report, page 62). Two varieties of tulips and two varieties of hyacinths were inoculated with lily mosaic virus from lily, the Zimmerman's Triumph tulip virus (see Ann. appl. Biol., XXV., 867, 1938) and *Cucumber virus 1*. The leaves of the plants were inoculated as soon as sufficient length had appeared above ground by rubbing with virus infected sap to which carborundum had been added. All the hyacinths shewed no abnormal symptoms, but one of ten William Pitt tulips inoculated with the lily virus produced a flower which shewed a pronounced deepening of colour along the veins and also a mild mottling of the leaves. All the control plants were normal.

(c) A Virus Disease of Chrysanthemum.

I. W. Selman.

Several specimens of late outdoor chrysanthemums were received from Dr. Cotton of Kew, suffering from a disorder which has been described as "a reversion to parental type." The major symptoms were discolouration, distortion and dwarfing of the flowers, a slight reduction in leaf size and a "breaking" of the flower colours. White, yellow and bronze varieties were affected, the latter showing yellow streaks on the florets. A few leaves showed a faint, chlorotic mottling.

Inoculation tests demonstrated that of five affected varieties all contained a virus of the *Cucumber Virus 1* type.* In contrast with the type virus, however, the fern leaf induced on tomato seedlings is not accompanied by a reflexing of the leaf lamina. A virus of this group was recorded for the first time on Chrysanthemum by Ainsworth (Ann. Rep. XXIV. p. 60), but there is no record of flower injury occurring.

Glasshouse chrysanthemums with almost identical symptoms to those received from Kew, have been received from Mr. Preston, in Shropshire. The disorder was most noticeable in the variety Pink Favourite, some 2% of the stock being affected.

* Subsequent work suggests that this may be a hitherto undescribed virus.

It is not yet certain whether cuttings from infected plants carry the disease but the importance of keeping chrysanthemum plants free from green-fly should be stressed, as the virus may be transmitted by this insect from the many nursery and garden plants which are liable to infection.

It seems highly probable that the so-called "running out" of chrysanthemum stocks which some growers will have experienced, may be due primarily to infection with this virus disease. The difficulty of early recognition and rogueing is intensified by the almost total absence of symptoms on the leaf.

(d) Tomato Mosaic.

I. W. Selman.

At least 90% of the widespread "Tomato Mosaic" may, under certain conditions, tend to induce the development of dark-brown stem lesions known as "Streak,"* which frequently proves fatal to the plant. An attempt is being made to establish more precisely the soil and weather factors which precipitate the appearance of necrotic stem and leaf lesions in a plant infected with a mosaic virus.

Date	Plant stage	Notes.
29/7	4—5 leaves ...	Plants inoculated.
9/8	——	Light-green dark-green mottle appeared.
22/8	12 leaves ...	Very faint mottle. Plants growing strongly.
25/8	13 leaves 13—14 ins. high	Mottle in leaves 8—10 only, very slight marginal leaf distortion.
29/8	15—16 leaves ...	Apical bud appears healthy. Faint mottle on a few mature leaves.
18/9	4 flower trusses open	Mottle extremely faint. 1st truss setting well.
28/9	5 trusses open ...	Mild mottle appearing on youngest leaves. Plants very vigorous.
21/11	——	Ripe fruit picked. All fruit was unblemished and of good flavour.
31/1	——	Young leaves showing a mild fern-leaf condition.

* Single virus streak of Ainsworth. Ann. Appl. Biol., 1933, p. 421.

Whilst collecting mosaic-infected material for the above purpose, a strain of "Tomato mosaic" (single virus streak group) has been found which does not readily induce streak lesions on the tomato plant. No case of streak has been observed during the six months in which the virus has been cultured, although other strains of the same virus group grown in tomato, under identical conditions, did induce streak.

The effect of this virus (A15) on tomato plants, variety E.S. 1, were studied in a preliminary experiment as shewn in the table on the previous page.

Experiments are now in progress to investigate the possibilities of introducing this virus into crop plants as a type of "vaccine" since plants infected with this virus do not appear to be susceptible to more virulent streak-inducing and fruit-mottling strains. Potato virus X will, however, induce mixed virus streak in combination with streak virus A15.

(e) Streak Disease and the Soil.

I. W. Selman.

An examination of some earlier work may be of interest to growers in this connection. At this Station Bewley (Ann. Rep., V.) and Ainsworth (Ann. Rep., XVII.), from counts of streaked plants on manurial plots, present data which agree consistently on the following points:—

1. Complete artificials without potash invariably induces the greatest number of streaked plants.

2. Complete artificials plus stable manure always induces more streaked plants than does complete artificials alone.

3. Complete artificials without nitrogen tends to give the smallest number of streaked plants.

All the plants in the above work must have been accidentally infected at various stages in the plants' history.

Tomato plants have been grown in sand culture by Volk (Phytopath, Zeitschr, 1931), who inoculated with streak virus just prior to fruiting. He reports the most virulent attack as occurring on plants receiving an excess of potash or phosphate or on those without nitrogen.

There is an unexplained discrepancy in the results of nitrogen omission, but the average grower is unlikely to encounter acute nitrogen deficiency. The danger of an unbalanced soil in respect to potash or phosphate is clearly evident.

3. Animal Pests.

1. Pests of Vegetables.

E. R. Speyer, W. Read, and O. Orchard.

(a) Caterpillars.

Leaves of broccoli were eaten by tomato-moth caterpillars (*Polia oleracea*, L.) after clearance of the tomato crop in October. Chrysalid cocoons of diamond-back moth (*Plutella maculipennis*, Curt.) had been introduced upon these plants: moths emerged from them during October, but did not appear to deposit eggs.

Foliage, especially round the growing point, of broad beans was severely injured by caterpillars of angle-shades moth (*Brotolomia meticulosa*, L.) during the autumn: the moths lay eggs on chrysanthemum at this time of year. Caterpillars of cabbage moth (*Mamestra brassicae*, L.) were also present. Moth jars containing treacle, beer, and sodium fluoride did not attract any moths of these species. Cabbage-white butterflies (*Pieris rapae*, L.) entered a house planted with cauliflower and laid eggs upon the foliage of young plants, which were severely injured by the caterpillars in October.

(b) Aphids.

The large green aphid, *Macrosiphum gei*, Koch. (= *solanifolii*, Ashm.) bred upon and caused severe injury to broad beans in heated glasshouses: infestation of French bean was less severe. Winged females ceased to appear in late autumn, and only wingless forms were present during the winter months.

Cabbage aphis (*Brevicoryne brassicae*, L.) was introduced into a glasshouse upon broccoli, and caused some injury during September, but practically disappeared from the plants later as a result of parasitism by braconids and probably of low temperatures. Peach aphid, *Myzus persicae*, Sulz., bred to an alarming extent with production of dark brown winged forms upon lettuce and cauliflower during the winter months after introduction into a well-heated glasshouse of a few individuals obtained from severely infested lettuce on a nursery in Scotland. At low temperatures the insect made little progress. This insect and *Myzus hieracii*, Kalt., are the species of aphid most generally associated with injury to

lettuce during the autumn and winter months and should not be confused with those which migrate to poplar and currant and live upon lettuce only during the summer. The young stages of *M. persicae* are greyish green and the wingless adults often assume a pink colour.

2. Control of Vegetable Pests.

(a) Caterpillars.

Sprays containing Derris or Lonchocarpus powders were very effective in rendering foliage of cauliflower and broccoli distasteful to caterpillars of Tomato and Cabbage Moth. In many experiments carried out but few caterpillars actually died as the result of contact with the powders or of eating foliage upon which they had been deposited. Their deterrent action, however, obviated any serious injury to the plants, and also prevented the caterpillars from obtaining sufficient nourishment to enable them to pupate. Caterpillars of cabbage butterflies (*Pieris rapae*, L.) on the other hand were usually killed by contact with the powders.

Derris powder was applied in the form of proprietary brands containing a spreader at the rate of 1-lb. to 20 gallons water. Lonchocarpus powder (kindly supplied by Messrs. G. Monro) prevented feeding by the caterpillars in small scale experiments when used at a strength equivalent to 1-lb. to 40 gallons water, with 4-lbs. soft soap or 3 to 4 fluid ounces liquid Agral as a spreader. Saponin, sulphonated lorol, and casein did not wet the foliage of vegetables so adequately as the latter agents.

As a stomach poison for caterpillars of angle-shades moth on broad beans, a mixture of 1 part powdered cryolite with 4 parts by weight of powdered pumice gave promising results.

(b) Aphids.

Fumigation with hydrocyanic acid gas by the jar method, using $\frac{1}{8}$ ounce sodium cyanide to 1,000 cu. ft. space did not destroy *Macrosiphum gei* on broad beans with temperatures below 54°F. during the period of fumigation. Fumigations at temperatures between 52°F. and 60°F. with proprietary cyanide powders also failed to kill this insect on French beans and *Myzus persicae* on lettuce, though they destroyed adults of white-fly. Pyrethrum powder applied to lettuce plants very severely infested with *Myzus persicae* killed practically

all the insects save for a small number in the hearts. A sheet of paper was placed on the soil surface surrounding a single plant just before application of the powder: 24 hours after 113 winged adults, of which 20 showed signs of life, and 523 young and wingless adults of which only 18 were not quite dead were collected from the paper. Those showing movement were transferred to untreated lettuce foliage, and although a few still moved after a further period of 24 hours, none recovered. Upon nurseries, infestation upon young lettuce is usually localised, so that application of pyrethrum powder can be restricted to small areas and the insects exterminated before the plants begin to heart. This practice has been attended with good results upon commercial nurseries.

Treatment of Broad Beans with pyrethrum powder for the control of *Macrosiphum gei* gave an estimated mortality amongst the insects of 50—60%. A proprietary dust of 5% Nicotine content gave a mortality of only 20% when applied under similar conditions.

4. The Control of Wireworms.

A method of preventing loss of tomato plants at the period when they are most susceptible to attack was tested. The principle of this method was the application of paradichlorbenzene as a deterrent to the dibbed holes immediately before planting out. Amounts sufficient to drive away the wireworm and prevent them from attacking the collars caused injury to the plants.

Under laboratory conditions carbon disulphide emulsions applied at the equivalent of 15 ounces carbon disulphide per square yard killed wireworms.

Applications of carbon disulphide at this rate proved very injurious to young plants. Other insecticides for use against wireworms have also been subjected to preliminary trials.

4. Woodlice Baits.

Castor Meal has proved, in small scale experiments, to be an adequate substitute for bran, which is at present unobtainable, in woodlice baits. The Meal is used at the rate of 28 lbs. to 1 lb. Paris green, *i.e.* the same as with bran. Addition of an equal weight of Dried Blood to the Castor Meal greatly increased the attractive quality of the bait: in this case Paris green was mixed in at the rate of 3—4 lbs. per cwt.

5. Cucumber Root Flies *(Mycetophilidae).*

Attacks of cucumber root fly maggots on cucumber crops were less numerous and severe than during preceeding years. Several substances have been tried as soil insecticides, however, in continuation of the attempt to improve existing control methods. Problems connected with the penetration of cucumber beds by emulsions and solutions of insecticides and the effect of their repeated applications on cucumber plants in full bearing have been studied on commercial nurseries. Solutions of dichlorodiethyl ether were found highly toxic to Sciarid larvæ in small scale trials late in the year but their effectiveness in the treatment of planted out cucumbers has yet to be determined.

Larvæ of *Sciara modesta*, Staeg. were placed upon pieces of Agar of pH values ranging from 5·0 to 9·0 in a petri dish: 6 larvæ were introduced to each piece and kept in the dark. After 4 days the majority had settled upon the agar with pH value 6·0 H. L. Gui (Bull. 524 Ohio Agriculture Expt. Stat., 1933 p.p. 16-17) found that the majority of larvæ of *Pnyxia scabiei*, Hopk. selected a pH value of 5·0

6. Mushroom Pests.

Attempts were made to compare the results of applying derris and pyrethrum extracts by means of an atomising apparatus of the type used in warehouse fumigation with those obtained by ordinary methods of distributing these insecticides. Owing to the difficulties of separating the two forms of treatment in a single shed, reliable comparison could not be made, but it appeared that the atomisation gave no better control of Sciarid flies than was obtained by the application of a proprietary pyrethrum powder from a dusting machine

7. Capsid Bug. *(Lygus pratensis*, L.)

Observations on commercial Chrysanthemum nurseries testify to the value of control measures referred to in the 24th Annual Report (1938 pp. 79-81). Both the dusts and the spray were outstandingly effective when applications were started immediately after the final potting. Measures taken at this early date proved far more effective than repeated applications late in the season, at a time when the insects had become firmly established.

8. Thrips.

On February 15th, adult females of Rose Thrips (*T. fuscipennis*, Hal.) which had evidently been hibernating in a wooden partition, were observed upon young shoots of nursery stock (variety Sylvia). Developing eggs were present in the ovaries of only a few of the insects and the largest had a length of only 0·12 to 0·15 mm.: a week later the largest eggs of further specimens collected measured 0·25 to 0·28 mm. in length as compared with a length of about 0·32 mm. at the time of laying. A considerable period of time must therefore elapse between emergence from places of hibernation and deposition of the first eggs.

Applications of pyrethrum powder during periods of sunlight were begun on the former date, and increase in the number of insects invading the shoots as well as injury to them was not checked.

Pot plants were dusted in direct sunlight and in the shade at temperatures of 74°F. and 60°F. respectively and leaves removed from them at intervals of 1, 2 and 5 hours after application. Immediately after removal the insects were dropped on to these leaves which were then enclosed in boxes. After a period of 24 hours, all those upon leaves from the plant dusted in the shade were either completely paralysed or dead, while those upon leaves dusted in sunlight were either unaffected or showed slight paralysis from which they subsequently recovered. On February 21st the powder was applied during dull periods at four day intervals, and this was followed by complete extermination of the infestation within a fortnight.

T. fuscipennis was recorded as breeding and causing extensive yellow patches upon fruit of strawberry in Bedfordshire during May.

An undetermined species of *Chaetanaphothrips* infested flowering fronds of Cymbidium on a Hertfordshire nursery in December. Greenhouse Black-fly (*Heliothrips haemorrhoidalis* Bouché) injured cyclamen foliage in N. Devon in February: both adults and young stages were killed by application of Pyrethrum powder. Onion Thrips (*T. tabaci*, Lind.) bred extensively upon foliage of French Bean at Cheshunt during November and December, but caused no material injury to the crop. Hydrocyanic acid gas even at concentrations which scorched the foliage was quite ineffective in killing the insect.

Application of Pyrethrum powder to young plants and distribution of Grade 16 Naphthalene after termination of the crop are recommended as control measures.

9. Carnation Tortrix (*Tortrix pronubana*, Hb.)

Caterpillars living upon Carnation, Geranium, and Cyclamen plants were not killed by the vapour of Tetrachlorethane in a glasshouse of 1,000 c.ft. capacity. The liquid was poured upon the path up to an amount of 1 pint, and the house kept closed for 5 days, during which time a mean temperature of 64°F. (max. day 77°F., min. night 53°F.) was recorded.

Caterpillars feeding upon Tomato foliage in glasshouses but not causing serious injury were received from Guernsey in January; these were reared to moths in March. Young caterpillars just hatched from an egg mass upon Cyclamen at Cheshunt invaded a young tomato pot-plant kept in the same cage, and destroyed the foliage.

Further observations upon the spraying of Cyclamen, Crassula, and Mimosa with lead arsenate paste 10 ounces, saponin ½ ounce, and water 10 gallons led to the conclusion that complete control of the pest can be attained by this method, providing that the spray is applied so as to obtain very thorough wetting of the foliage.

10. Miscellaneous Insecticides.

Many minor problems of immediate concern to members have been investigated and there has been an increase in the amount of materials submitted by members for examination. New insecticides are continually being sought for the control of major pests such as red spider mite, tomato moth and other caterpillars, thrips, etc., but the time available for research of this nature becomes less each year owing to the increase in the amount of routine work which has be undertaken.

4. Chemical Problems.

O. Owen.

A much larger number of fertilisers than usual have been submitted for examination. An interesting feature has been the number of samples of various guanos. Typical analyses are as follows:—

	Nitrogen (N)	Potash (K_2O)	Phosphoric Acid (P_2O_5)
1.	7·7	4·1	9·1
2.	7·7	4·2	8·5

General mixed fertilisers, a number of samples of sulphate of potash, and dried blood have also been examined. The appearance of dried blood samples often causes the grower concern, and in the cases dealt with such samples have been tested not only for total nitrogen but also for the ease with which decomposition takes place in the soil. It may be noted that in all cases samples have been up to or over the guaranteed specification and have been satisfactory in the other respect.

Attempts are therefore being made to find a method whereby it will be possible to measure quickly the rate at which the nitrogen becomes available in the soil.

The examination of general nursery soils to decide manurial requirements has proceeded normally. It appears that in some soils a deficiency of magnesium may exist and experiments will be conducted during the coming season to test this suggestion.

The effect of the manurial treatment on the nitrogen, phosphoric acid, and potash contents of some market garden crops are shewn in the table on page 46.

Results for Cheshunt Early Giant lettuce were reported in 1937. It will be observed from the above table that with one exception the omission of any nutrient depresses the percentage of that nutrient in the crop. Further, the omission of phosphates, in all cases except that of carrot leaves reduces the percentage of potash in the material. This finding is in accordance with the results obtained from tomato foliage. The omission of potash does not appear to have any appreciable or consistent effect on the nitrogen and phosphoric acid contents. This is in contrast with the results for tomato foliage where omission of potash from the nutrient causes a definite increase in the phosphoric acid content.

Percentage in oven dried material.

		Nitrogen	Phosphoric Acid (P_2O_5)	Potash (K_2O)
Carrot leaves	Complete artificials	2.65	.713	5.65
	No phosphates	2.80	.636	7.45
	No nitrogen	2.57	.623	7.67
	No potash	2.47	.688	4.45
Carrot roots	Complete artificials	1.52	1.29	6.13
	No phosphates	1.61	.828	5.37
	No nitrogen	1.14	.921	4.67
	No potash	1.59	1.04	3.50
Cabbage	Complete artificials	3.61	1.18	4.79
	No phosphates	2.99	1.10	4.28
	No nitrogen	3.22	1.14	5.70
	No potash	3.78	1.50	5.01
Beetroots	Complete artificials	3.04	1.52	4.79
	No phosphates	2.43	1.16	4.31
	No nitrogen	1.92	1.13	4.04
	No potash	2.58	1.26	4.01
Beet leaves	Complete artificials	3.31	1.07	4.17
	No phosphates	3.10	.976	3.97
	No nitrogen	2.76	.971	7.06
	No potash	2.93	1.07	3.84
Bean leaves	Complete artificials	2.78	.847	4.47
	No phosphates	2.30	.588	3.82
	No nitrogen	2.71	1.03	4.79
	No potash	2.80	.748	2.01
Bean pods	Complete artificials	2.79	1.15	4.12
	No phosphates	2.47	.977	3.81
	No nitrogen	2.72	.885	2.91
	No potash	2.78	.998	2.77

On a number of occasions information has been sought as to the amount of plant food removed by a crop of winter lettuce. Assuming Cheshunt Early Giant to be planted at 50,000 to the acre, on the basis of figures already reported the crop would remove approximately 26½ lbs. nitrogen, 13½ lbs. of phosphoric acid and 73 lbs. of potash.

5. Miscellaneous.

1. The Effect of Reduced Day-Length on Beans Grown under Glass.

H. L. White.

American workers have shewn that certain types of bean produce a heavy crop if the day-length is reduced to 7-hours, while no flowers are produced with a 14-hour day-length.

Preliminary experiments have been undertaken to test the effect of reducing day-length below 10-12 hours, the period prevailing in English glasshouses when this crop is usually grown.

Interesting differences in the crop were observed and are sufficient to justify experiments on a larger scale. Plants of the varieties Canadian Wonder (Dwarf French), Tender and True (Climbing French) and Ne Plus Ultra (Scarlet Runner) were subjected to treatment for a period of one month, from sowing on 7th February. The average period of daylight per 24-hours to which 36 plants of each variety were exposed under three treatments was 11·3, 9·1, and 7·6 hours respectively. The plants were grown in 12 in. pots, four plants in each pot.

Ne Plus Ultra, a variety unsuitable for forcing in glasshouses produced no pods under any of the treatments and the date of opening of the flowers of the other two varieties was not affected by reduced day-length.

Canadian Wonder.

A reduction of approximately 2-hours day-length below 11·3 hours gave a crop increase of 71%, divisible into 20% average increase in pod-weight and 44% increase in number of pods per plant, while a reduction of approximately 4-hours day-length gave the same crop weight as that obtained with full daylight.

Increase in vegetative growth was approximately as follows:—

Full daylight.	Height 89%.	Area of 1st leaves 6·7 times.
2-hours reduction.	Height 62%.	Area of 1st leaves 3·8 times.
4-hours reduction.	Height 52%.	Area of 1st leaves 3·9 times.

The plants were grown on in full daylight and the increase in area of the terminal leaflets of the first trifoliate leaves was similar in all treatments.

At the termination of the experiment, the dry weight of plants subjected to 2-hours reduction was only 4%, and of those subjected to 4-hours reduction was as much as 35% below the weight of plants grown with full day-length, the latter reduction being associated with appreciable increase in ratio of tops to roots—a well-known feature of light deficiency.

Tender and True.

A reduction of approximately 2-hours day-length had no effect upon the crop, but a reduction of approximately 4-hours day-length gave a 34% decrease of crop weight due principally to the small number of pods produced.

Increase in vegetative growth was approximately as follows :—

Full daylight. Height 459%. Area of 1st leaves 4 times.
2-hours reduction. Height 317%. Area of 1st leaves 4·2 times.
4-hours reduction. Height 219%. Area of 1st leaves 4·3 times.

A more accentuated reduction in height was thus obtained by 4-hours than by 2-hours reduction of daylight, increase in growth of the 1st leaf not being appreciably affected. On the other hand, the terminal leaflets of the first trifoliate leaves were reduced in area by 26% with 2-hours, and 54% with 4-hours reduction of daylight.

The plants were grown on in full daylight after the termination of the experiment, and increase in area of these leaves was recorded as 21%, 35%, and 42% respectively.

The most striking feature was the effect which 4-hours reduction of daylight produced in converting the climbing habit of this variety into a dwarf habit which was retained for a period of 2 months after termination of the experiment, accompanied neither by earlier date of maturity nor by increase in crop weight.

Reduction of 2-hours in day-length produced moderate reduction of vegetative growth without corresponding reduction in crop weight.

2. Chemical Treatment of Lettuce Seed.

H. L. White.

Seeds of Cheshunt Early Giant were treated with Nicotinic acid in various dilutions and the effect upon subsequent growth was estimated by measurement of leaf area, corresponding leaves being taken for comparison.

Dilution.	Mean area of 1st leaf.
Untreated	1·22 sq. cm.
1 in 200,000	1·35 sq. cm.
1 in 50,000	1·93 sq. cm.
1 in 10,000	2·32 sq. cm.
1 in 2,000	2·32 sq. cm.
1 in 400	No germination.

The results would appear to justify further observations.

Certain chemical treatments virtually changed the coats of black seed to white, but did not produce appreciable differences in subsequent growth of seedlings.

3. The Growth Rate of the Young Tomato Plant.

D. W. Goodall and B. D. Bolas.

During the year 1936—1937, detailed observations were made on the dry weight changes in the tomato plant at the eight-leaf stage. These results have now been analysed, and will be published in detail elsewhere. A summary of the results relating to the plant as a whole is, however, given here.

The mean rate of growth of these plants during the summer months is considerably higher than most of the rates that have been recorded for other plants. The mean net assimilation rate during the summer (that is, the amount of new material formed per unit of leaf surface) is, on the other hand, slightly less than the average for other plants. The reason for the high growth rate proves to be the high proportion that the leaves form of the plant. In the tomato plant at this stage, nearly 75% of the total weight is leaf tissue, whereas in many other plants the figure is little more than 50%.

The assimilation rate has been shewn to be related to various environmental factors--day and night temperature, light intensity and duration, and atmospheric humidity. Of these, however, only light intensity can be shewn to have an independent effect on the plant's assimilation.

APPENDIX A.

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APPENDIX B.

Manurial Treatment in Tomato Experiments.

(Soil Steam Sterilized.)

(1) Lime.

All houses received ground caustic lime at the rate of 2-tons per acre.

(2) Stable Manure.

No stable manure, except plot 8, house 4, and plots 3 and 7, house 5, which received 15-tons per acre.

(3) Base-dressing.

Houses 1 to 12 received ½-ton sulphate of potash per acre, except in houses 4 and 5 where the following treatments were given :—

(*a*) ½-ton sulphate of potash per acre, plot 7, house 4., plots 2 and 4, house 5.

(*b*) ½-ton sulphate of potash and ½-ton bone meal per acre, plot 5, house 4, plots 5 and 8, house 5.

(*c*) ½-ton each per acre, hoof and horn, bone meal and sulphate of potash, plots 6 to 8, house 4, plots 1, 3, 6, and 7, house 5.

(4) Top-dressing.

SULPHATE OF POTASH.—All houses received a first top-dressing of sulphate of potash at the rate of 5-cwts. per acre.

FERTILIZER MIXTURE.—All houses except plots 1, 2, 3 and 10, 11 and 12, house 4, received 5-cwts. per acre of the following mixture every fourteen days at discretion :—

3 parts sulphate of ammonia.
2 parts dried blood.
7 parts 30% superphosphate.
5 parts pure dissolved bones.
½ part bone flour.
2½ parts sulphate of potash.

All houses received three top-dressings of the following mixture at the rate of 5-cwts. per acre :—

1 part sulphate of ammonia.
1 part nitrate of potash.
3 parts superphosphate.
5 parts dried blood.

Appendix C.

Manures applied to Plots 1-3, and 10-12 in Tomato House 4.

Plot.	TITLE.	Base Manure in Lbs. per sq. yd.				* Top-dressing in Lbs. per sq. yd.			
		Lime.	Stable Manure.	Basic Slag.	Sulphate of Potash.	Super-phosphate.	Sulph. of Ammonia.	Nitrate of Soda.	Sulph. of Potash.
1	Complete Artificials (I.) without Nitrogen	1.0	—	0.4	0.1	0.5	—	—	0.2
2	Unmanured	1.0	—	—	-	-	—	—	-
3	Complete Artificials	1.0	—	0.4	0.1	0.5	0.2	0.2	0.2
10	Complete Artificials with Dung	1 0	7	0.4	0.1	0.5	0.2	0.2	0.2
11	Complete Artificials without Phosphates	1.0	—	—	0.1	—	0.2	0.2	0.2
12	Complete Artificials without Potash	1.0	—	0.4	—	0.5	0.2	0.2	—

* The Top-dressing was applied in eight equal instalments.

Appendix D.

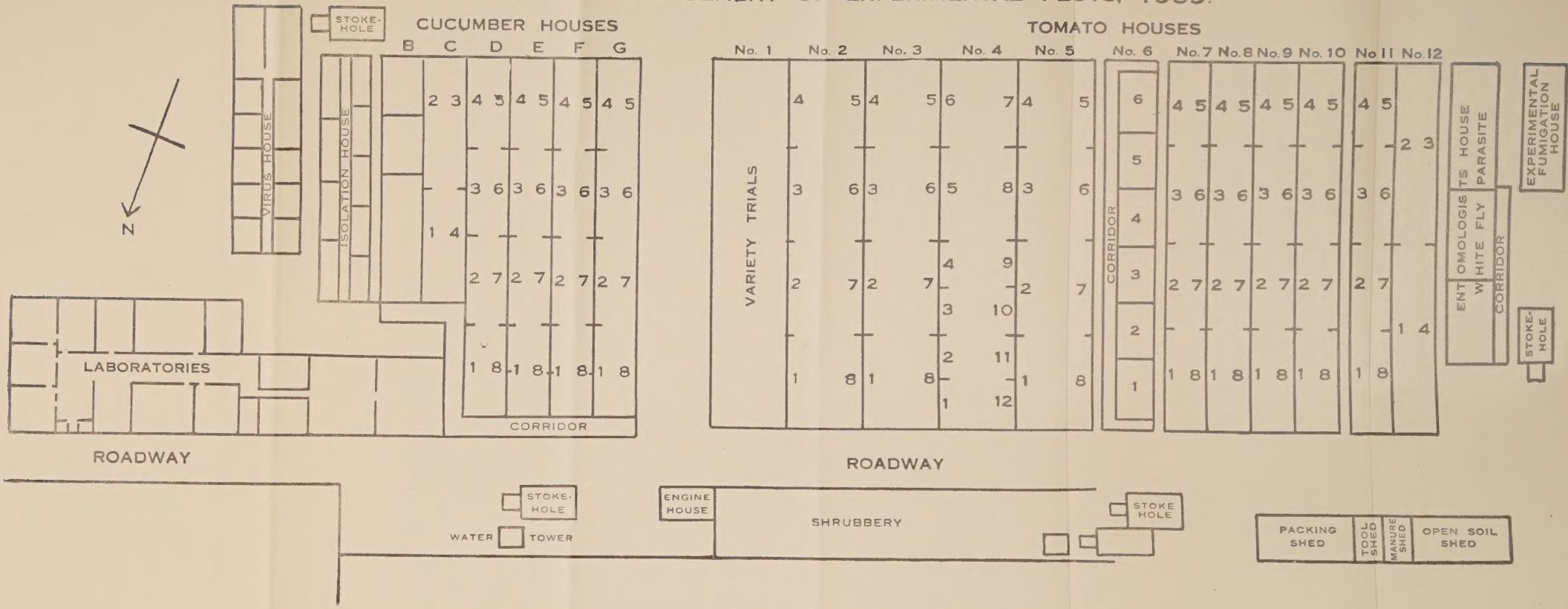
Dates of Cultural Operations, 1938—1939.

Crop.	Sown.	Potted into 60's.	Potted into 32's.	Planted out in borders.	First Mulching.	First Top Dressing.	First Fruit Picked.	Last Fruit Picked.
Cucumbers	Dec. 16 1938	——	Jan 20 1939	Feb. 16 1939	Mar. 17 1939	Mar. 28 1939	Mar. 15 1939	Sept. 13 1939
Tomatoes	Dec. 16 1938	Jan. 23 1939	——	Mar. 6 1939	——	May 9 1939	May 10 1939	Oct. 20 1939

Month.	Air Temperatures						Grass Temp.			Rainfall				Mean Soil Temperatures		Hygrometer				Bright Sunshine		Barometer
	Mean		Absolute Max.		Absolute Min.		Av. Min.	Absolute Min.		Total Precipitation	No. of Days Pptn	Greatest Fall				Dry Bulb	Depres. of Wet Bulb	Relative Humidity %	Dew Point	Total No. of Hrs.	Daily Average.	
	Max.	Min.	Tem.	Date	Tem.	Date		Tem.	Date			Amt.	Date	1 ft	2 ft.							
	°F.	°F.	°F.		°F.		°F.	°F.		Ins.		Ins.		°F.	°F.	°F.	°F		°F.			Ins.
January	45.7	36.3	54.0	7th 8th 14th 25th	22.0	5th	33.7	20.0	5th	5.64	21	1.5	25th	40.1	42.5	41.4	1.9	85.6	37.1	49.4	1.59	29.62
February	50.2	35.7	60 0	15th	25.0	20th	32 7	23.0	20th	1.34	6	0.65	7th	40.1	41.7	44.6	2.3	83.6	39.5	105.6	3.77	30.22
March	50.3	36.0	61.0	3rd	28.0	10th	32.8	25.0	10th 12th	1.38	10	0.36	21st	41.6	42 9	45.1	3.4	76.8	37.9	131.8	4.25	30.05
April	59.8	38 3	75.0	12th	31.0	2nd 8th 24th 25th	34.6	25.0	25th	3.18	16	0.86	29th	46.9	46.9	53.5	4.6	70.2	43.6	153.5	5.12	29.99
May	63.5	42.7	77.0	26th	35.0	3rd	39.3	30.0	3rd	1.54	7	0.67	15th	52.6	51.7	55.8	5.0	71.5	46.2	158.2	5.10	29.90
June	69.5	48 5	86.0	7th	40.0	12th	45.9	36.0	12th	1.58	13	0.61	10th	60.6	60.2	62.0	6.3	67.8	50.5	204.9	4.83	30.04
July	68.8	50.3	82.0	4th	40 0	2nd	47.4	37.0	2nd	2.36	17	1.25	20th	62.1	61.7	64.8	4.8	73.7	55.8	158.9	5 13	29.95
August	73.2	51.8	81.0	20th	38.0	16th	49.0	38.0	16th	3.88	13	1.05	5th	61.9	...	65.5	4.0	78.9	58.4	158.6	5.39	30.13
September	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	..	...	...	...	...	...
October	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...
November	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...
December	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	.	...	...	...	...

Total rain from January to August, 20.9 ins. No. of days precipitation, 103. Total bright sunshine from January to August, 1120.09 hours.

DIAGRAM SHEWING ARRANGEMENT OF EXPERIMENTAL PLOTS, 1939.



EXPERIMENTAL AND RESEARCH STATION,
CHESHUNT, HERTS.

WAR-TIME NOTES. No. 1.

Repairing Small Holes in Glass.

During recent months many requests have been received from growers for some method of "patching" holes made in glasshouses by shell splinters. After many enquiries a proprietary compound was found which can be used for cementing glass to glass. This is Bostik B. Glazing Compound manufactured by the B. B. Chemical Co., Ltd., Ulverscroft Works, Leicester.

Where a relatively small hole has been made in the glass a patch of glass can be fixed over it in the following manner:—

1. First make sure that all the glass is free from dirt and perfectly **dry.**
2. Fit special extending nozzle to Bostik tube, then fit extending lever key so that the U aperture at end of nozzle lies flat on the glass.
3. Place the nozzle flat on the pane of glass which has been damaged. Turn the key clock-wise (away from you) and apply a thin, flat and continuous bead of Bostik to the glass, keeping the Bostik bead as far away from the hole in the glass as possible.
4. Allow the bead of Bostik to dry for 5 to 6 minutes.
5. Place the piece of glass which is to serve as a "patch" over and on to the bead of Bostik, pressing downwards lightly all over to ensure uniform adhesion.
6. Finally, apply a bead of Bostik round the outer edge of the patch, so that the edge of the patch is sealed to the fixed glass.

NOTE.—These operations must not be undertaken in wet weather.

Glass substitute materials, of which there are many on the market, can be used as patches instead of glass, and fixed in position in the same way.

Cracks in the glass can be sealed by covering them carefully with a bead of the compound.

This method of patching glasshouses will appeal particularly to the small grower. It is worth consideration for it uses up small pieces of glass and contributes towards national economy.